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DOCUMENT INFORMATION

Sheet 1 of 1

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☐ Pretreatment ☐ LAW Vitrification ☐ External Interfaces

Document is applicable to ALARA (as determined by the originator)? ☐ Yes ☒ No

Applicability to ALARA means that the item has the potential to affect doses, contamination levels, or releases to the environment. (See 24590-WTP-GPP-SRAD-002, *Application of ALARA in the Design Process*, sections 4.1 and 4.2 for more information.)

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Special Instructions for PDC

Material Selections for Building Secondary Containment/Leak Detection

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History Sheet

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3	8-14-03	Clarified transfer lines source term, added AEA statement and re-Issued for Permitting Use	HM Krafft

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1 Introduction

The Washington Administrative Code, Chapter 173-303 WAC, *Dangerous Waste Regulations*, requires the use of leak detection and secondary containment for systems containing dangerous waste. This report discusses the potential use of coatings and stainless steel for use as secondary containment in the Balance of Facility (BOF) as well as the High Level Waste (HLW), Low Activity Waste (LAW), Pretreatment (PTF), and Laboratory (LAB) facilities. It also describes the probes used in the sumps for leak detection.

Any fluids released to the secondary containment will flow to the sumps. Sumps that are always dry except for off-normal situations will be constructed of ASTM A240 type 304L or a more corrosion resistant alloy. More resistant alloys include ASTM A240 type 316L stainless steel or ASTM B688 UNS N08367 or ASTM B625 UNS N08926, 6-percent molybdenum (6% Mo) alloy. Sumps that are always wet will be a 6% Mo alloy. The fluid level in the sumps will be monitored by bubbler or radar level detectors.

2 Applicable Documents

None

3 Description

After describing selected system features and operating concerns, a brief description of the corrosion factors for sumps, cell liners, and leak detectors is discussed.

System Features

- Secondary containments shall be remotely flushed as needed. All cells with secondary containment are provided with wash rings that can flush the cell with 8-percent sodium hydroxide, 12-percent nitric acid, or process water. The flush solution flows to sumps from which it is removed.
- Sumps that are normally dry will be flushed and drained. Wet sumps maintain a liquid level.
- Stainless steel cell liners are used in inaccessible areas or in areas where a potential spill of waste would require a higher level of corrosion protection. Coatings may be used in areas where repair maintenance can be performed.
- The portion of the bubbler tube (leak detection) in the sump will be constructed of the same material as the sump. If process conditions require it, a more corrosion resistant alloy will be used.
- The bubblers are fed with dry process air or instrument air, dew point of 40 degrees below 0 Fahrenheit (-40 °F).
- Airflow rates are sufficiently small that aerosols formed by the air bubbling through the liquid and that could deposit on the probe surfaces will not form.
- The bubblers are continuously operated at a pressure greater than or equal to the external pressure so that liquid does not rise in the bubbler.
- Depending on the design, the radar level detector wave-guide may or may not contact the liquid. Any portion of the wave-guide below the top of the sump will be constructed of the same material as the sump. If process conditions require it, a more corrosion resistant alloy will be used.

Considerations:

Several factors must be considered in specifying the materials of construction. These include temperature, lifetime dose, expected chemistry including pH (the negative logarithm of the hydrogen ion activity), and time of exposure.

Temperature - Most regions in the 5 facilities will operate in the 75 °F to 125 °F range with an upper limit of 150 °F. In exceptional regions, associated with the melters, air temperatures can significantly exceed 300 °F. Melter cell liner temperatures will be maintained at significantly less than 300 °F due to the cell ventilation systems

Radiation – The 40 year integrated gamma radiation dose within the PTF are estimated to be as high as 26,000,000,000 rad, though most locations are less. The highest expected 40-year dose rate in waste transfer lines is between the PTF and the HLW facility. The dose rate for the PTF to HLW facility transfer line is estimated to be less than 60,000,000 rad based on a bounding assumption that the transfer line is full of waste at all times.

pH - The pH within process vessels can vary depending on the operation. Process solutions range from 50 -percent sodium hydroxide to about 40 -percent nitric acid though no one vessel is expected to be exposed to the entire range of pH values.

Time of Exposure – Time of exposure will affect the degree of uniform corrosion that can occur. Because pitting and cracking generally have some degree of incubation period, short exposures to potentially corrosive conditions may not have an effect.

3.1 Sumps

Sumps are either dry sumps or wet sumps. Dry sumps may be constructed of 304L or more corrosion resistant alloys, including 316L stainless steel and 6% Mo alloy. The wet sumps will normally have some liquid present. Because of uncertainties about the chemistry of the solutions in the sump, evaporation rates, and the effects at the liquid/air interface, the wet sumps will be a 6% Mo alloy.

3.2 Liners

3.2.1 Coatings

Both mechanical and chemical factors are important in the selection of special protective coatings. The mechanical factors include foot traffic, fork lift operation, and dropping of or installation of equipment. The chemical effects include, but are not limited to, pH, radiation, and temperature.

Novolac type epoxies are available that can withstand temperatures to about 300 °F, lifetime doses to about 200,000,000 rad, and concentrated caustic or nitric acid for several hours.

The combined effects of pH, temperature, and radiation on coatings are not well defined but would be expected to reduce the useful life. No situation is expected where temperatures above 300 °F will be combined with pH extremes.

A shorter exposure of coatings to any of above conditions will result in a longer coating life. Exceeding any of the above conditions requires access for maintenance of the coating.

To determine the level of protection needed, several leak options are evaluated:

High pH solutions.
All of the suggested coatings are subject to failure if there is extended exposure to strong caustic. Surfaces should be flushed within about 2 days.

Acid leaks in the absence of waste.
Coatings can be used if they can be washed within about 2 days otherwise they could be destroyed by long-term exposure (greater than several days depending on the concentration) to nitric acid. Where failure of the coating could lead to exposure of concrete to acid solutions, coatings are not recommended.

Water leaks in the absence of waste.
Coatings are acceptable, except in high radiation areas where human access for performing coating maintenance is not possible.

Acid or water (pH < 12) leak with waste present.
As noted above for acid leaks, coatings are not recommended except where maintenance is feasible. pH values near or less than about 0 are of primary concern.

3.2.2 Metal liners

To determine the level of protection needed, several leak options are evaluated:

High pH solutions.
304L is resistant to caustic solutions.

Acid leaks in the absence of waste.
304L was specified as the liner material. The corrosion resistance of 304L is very good for nitric acid.

Water leaks in the absence of waste.
In the absence of waste, no failure of the 304L liner is expected.

Acid or water (pH < 12) leak with waste present.
With 304L, washing within a day of the leak is preferred. However, as the temperature of any leaking fluid on the liner will be much lower than that in the pipe/vessel, no accelerated corrosion of the liner is anticipated. Further, because in a typical fabrication, the weld is always considered to be more prone to defects that result in leaks, vacuum box testing will be conducted on liner plate welds as a precautionary measure to ensure weld integrity and eliminate potential leakage to the concrete.

3.3 Leak Detection

Should leaks occur, the fluids will flow to the sumps where probes using radar level detectors or bubblers will detect the liquid in the sump. Bubbler tips will frequently be exposed to the solution, whereas the radar wave-guides are not expected to be exposed. Factors considered in reviewing the probe performance are:

- external environment
- internal environment
- immersion environment
- tip environment

The external environment of both probe types above the liquid level and the internal environment of the wave-guides is air which is benign. The internal environment for bubblers is dry air and is extremely benign. The wetted portion of immersed probes will be in the same solution as the sump in which it is located. Due to the expected evaporation of the solution by the dry air, deposits may form on the bubbler tip. The rest of the immersed portion of the bubbler will be as resistive to corrosion as the sump in which the bubbler is located because it is made of the same material as the sump. If process conditions require it, a more corrosion resistant alloy will be used.

3.3.1 Bubblers

Because the instrument air or process air inside the bubbler is very dry, the solution at the bubbler tip will dry and any soluble material will precipitate onto the bubbler tip. Even under these conditions the uniform corrosion for the tip will be small, estimated at less than 1 mil (0.001 inch) per year. Cracking is not likely even if chloride builds up because the stresses at the tip are expected to be small and the material is the same as the sump; even if cracks occur, a cracked tip will not affect the bubbler operation.

On the other hand, pitting is possible. Pits, however, will be small and plugged with corrosion products. Little if any air loss will occur. Additionally, because the bubblers sense a pressure differential and not an absolute pressure, the loss of air is not critical.

3.3.2 Radar Wave-Guides

The wave-guide is not expected to be wetted. However, if it is, the duration should be sufficiently small that combined with the material of construction, no uniform corrosion is expected. Cracking and pitting are not likely, and the effect of small cracks or cracks in the wave-guides is unknown.

Radar wave-guides are not expected to corrode significantly if immersed. Any portion of the wave-guide below the top of the sump will be constructed of the same material as the sump or, if process conditions require it, a more corrosion resistant alloy. Nevertheless, immersion of the wave-guide is not recommended.

4 Conclusions

- Cell liners are required as a secondary containment.
- Coatings are not recommended as process cell liners unless they can be maintained.
- 304L is acceptable for cell liners because it is compatible with the expected temperature and radiation limits. It is susceptible to corrosion under certain conditions but they will be counteracted by remote flushing.
- Alloys more corrosion resistant than 304L are not needed for the cell liners.
- Dry sumps will be constructed of 304L, 316L stainless steel, or 6% Mo alloy. The remaining sumps are constructed of a 6% Mo alloy.
- Because the immersed portions of the bubbler will be the same material of construction as the containing sump, the corrosion, in general, will be the same for both. However, because deposits are

likely at the bubbler tip, the bubbler may pit at the tip. No significant effect on bubbler operation is anticipated.

- If process conditions will result in the immersion of the radar wave-guides, a more corrosion resistant alloy such as 6% Mo is used.

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MASTER DISTRIBUTION SCHEDULE

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